

Review

Interpretation of anogenital findings in the living child: Implications for the paediatric forensic autopsy

Dawn E. Elder MB ChB, FRACP *

Departments of Paediatrics, Wellington School of Medicine and Health Sciences, University of Otago, P.O. Box 7343, Wellington, New Zealand

Received 5 November 2006; received in revised form 4 January 2007; accepted 5 March 2007

Available online 20 July 2007

Abstract

Examination of the anogenital area is an important part of the forensic autopsy when the death of a child or adolescent has occurred in suspicious circumstances. Practitioners undertaking forensic autopsy in this age-group should be familiar with the range of genital findings found in non-abused living children and adolescents, the genital findings described in association with sexual assault and accidental trauma to the genital area in the living child and the medical conditions that may be misinterpreted as signs of sexual abuse. This review summarises the recent literature on genital findings in living children and adolescents and discusses the implications for the examination of the anogenital area as part of the paediatric forensic autopsy.

© 2007 Elsevier Ltd and FFLM. All rights reserved.

Keywords: Forensic medicine; Child abuse; Homicide; Trauma; Sexual abuse; Anogenital findings

1. Introduction

Since the landmark article by Kempe in 1962, much has been written about examination findings diagnostic of inflicted injury.¹ Around 10% of children and 20% of girls experience sexual abuse in childhood and adolescence.^{2,3} With increasing recognition of the prevalence of childhood sexual abuse, clinicians have sought to define physical findings diagnostic of sexual assault. Assessment of the genitalia after death has been less well described. This paper reviews the current literature on anogenital findings in living prepubertal children and adolescents and discusses implications for interpretation of findings at autopsy when sexual assault is a differential.

2. Genital anatomy in prepubertal female children

Genital findings in prepubertal female children reported as usual or frequently seen have been documented by

examining children not exposed to sexual abuse. An agreed definition of the structures described can be found in the APSAC glossary of terms.⁴ No reports exist of congenital absence of the hymen.⁵ The newborn hymenal mucosa is fleshy and redundant and anatomic features such as tags, longitudinal intravaginal ridges, external hymenal ridges and hymenal bands may be seen.^{5–7} A hymenal tag is an elongated projection of tissue arising from any location on the hymenal rim. Longitudinal intravaginal ridges are narrow, usually multiple, mucosa-covered ridges on the vaginal wall that may be attached to the inner surface of the hymen. External hymenal ridges occur in the midline as a longitudinal ridge of tissue on the external surface of the hymen. Hymenal bands can extend across the hymenal orifice resulting in a septate appearance.

Prepubertal hymenal configurations observed include fimbriated, crescentic, annular, microperforate, septate and cribriform types.⁸ The newborn hymen is usually annular or fimbriated with hymenal tissue around the circumference of the vaginal opening.⁷ Fimbriated hymens smooth out with labial traction. By a year some infants with annular or fimbriated hymens will have developed a crescentic hymenal configuration and septate hymens may

* Tel.: +64 4 3855999; fax: +64 4 3855898.

E-mail address: dawn.elder@otago.ac.nz

become annular.⁹ By three years the crescentic configuration predominates followed by annular and less commonly fimbriated and sleeve-like hymens. By 9 years, 90% of girls have crescentic hymens.¹⁰

The hymenal opening is usually central but may be ventrally placed.⁷ Openings towards the posterior hymen are rare as are imperforate or nearly imperforate hymens.⁶ The presence of a hymenal band or septate hymen should alert the examiner to check for internal genital anomalies such as duplication of the vagina. Notches may be seen in the superior hymen but are less common by three years as annular hymens with superior notches evolve into crescentic hymens.¹¹ Lateral notches may persist or resolve through early childhood and superior notches can appear.¹⁰ Notches in these positions should not be interpreted as evidence of healed trauma unless the original injury has been documented. No congenital deep notches have been documented in the posterior hymen from the 4 to 8 o'clock position at birth or throughout early childhood in non-abused children.^{7–10,12} Superficial notches, those extending less than half the width of the hymenal membrane, can be seen in the inferior hymen and are usually associated with a mound. A mound is a solid, localized rounded and thickened area of tissue on the edge of the hymen. It may be created by the hymenal attachment of a longitudinal intravaginal ridge.

In the first year of life hymenal tags may appear as a new finding but by three years of age most have resolved. Longitudinal intravaginal ridges persist but external ridges are less commonly present at 1 and 3 years of age and not seen in late childhood. Mounds on the hymen may be the residua of external ridges.⁹ Vestibular bands are more common at 1 year than in the newborn period and are usually associated with the urethral meatus. Hymenal bands, mucosal connections of tissue between the hymen and the perihymenal tissues, are common.^{13,14}

Some decrease in the inferior hymenal width at the 6 o'clock position may occur through childhood but hymen is always present in this position in non-abused children and differences with age are small.¹⁰ A decrease in width of the inferior hymen may be associated with obesity.^{10,14} Irregularities of the hymenal edge are common.¹⁴ An appearance of irregularity may occur if the hymen is folded out or backwards into the vagina and should not be misinterpreted as loss or absence of the hymen.¹⁵ Techniques such as the use of the prone knee–chest position for examination or manipulation with a swab will facilitate full visualisation of the hymen.

Vascularity of the hymen is seen frequently in non-abused children and should not be considered significant in the absence of other more specific indicators of injury.¹³ Erythema of the vestibule has been described in around 50% of prepubertal girls and if marked usually indicates non-specific vulvovaginitis which is common in this age-group.^{14,16} Erythema of the labia majora in an oval distribution around the external genitalia may be associated. The linea vestibularis, a white linear structure seen in the

mid-posterior vestibule has been reported in 10% of newborns.¹⁷ A partial linea vestibularis, a white spot seen in the mid-posterior vestibule, has been reported in 14% of newborn girls. These structures can change over time either becoming more or less prominent or disappearing completely and should not be misinterpreted as healed trauma.¹⁸ Failure of midline fusion occurs occasionally as a congenital anomaly resulting in a defect on the perineum that may be misinterpreted as a fissure or a scar. Observation of no change over time confirms the diagnosis.

Labial fusion appears to be rare in newborns.¹⁹ Posterior labial fusion pronounced enough to obscure the inferior hymen was seen in up to 8% of 1 year old infants,^{9,19} but usually resolves by 3–4 years of age.^{11,19} Partial labial fusion is more common.¹² An association with sexual abuse has been reported but given the frequency of labial fusion in non-abused children this finding is non-specific without other indications that sexual abuse has occurred.^{20,21}

An increased transhymenal diameter was once considered diagnostic of penetration.^{22,23} It is now clear that hymenal diameter varies with age, hymenal configuration, patient relaxation and examination technique.^{11,15,16,24} Measurements of the hymenal orifice diameter cannot predict whether or not sexual assault has occurred in a prepubertal child.^{25,26}

3. Anal anatomy in male and female children

The perianal region has been less extensively studied but some normative data exist. Erythema, pigmentation and venous congestion are common findings.²⁷ Wedge-shaped smooth areas can be seen in the midline both posteriorly and anteriorly. Anal skin tags or folds are seen anteriorly and posteriorly but appear rare outside the midline.^{27–29} Anal dilatation is seen in non-abused children. Total anal dilatation can be associated with constipation or stool in the rectum and is more commonly seen when a child is examined in the prone position.²⁹ Neurological causes of anal laxity should be considered.³⁰ Conflict exists in the literature about the significance of anal dilation as a marker of previous sexual abuse with anal penetration.^{31–33} Its presence should not be considered specific evidence of anal assault.³⁴

4. Genital anatomy in adolescents

Less is known about the range of genital findings seen in non-abused adolescents. At puberty the hymenal membrane changes considerably under the influence of oestrogen. Myths about the hymen been 'broken' at first intercourse have lead to the misconception that it is possible by examination alone to determine whether or not sexual intercourse has taken place on at least one occasion. Adams et al. found very few differences in hymenal morphology between 27 adolescents with experience of consensual sexual intercourse and 58 who denied intercourse.³⁵ Deep notches and complete clefts were more commonly found in those who had experienced sexual intercourse

but were still only seen in 40% of that group. The two adolescents who denied sexual intercourse but had a deep or complete cleft reported experiencing accidental trauma to the area. The width of the hymenal rim was not significantly different between the two groups. The reason for the lack of hymenal injury after first intercourse is most likely because of the increase in hymenal elasticity that occurs during puberty.³⁶ This characteristic of the adolescent hymen contrasts with the more rigid prepubertal hymen which is tender to touch and less well lubricated by mucosal secretions.

5. Appearance of the anogenital region after death in children

There have been no published reports of the post mortem appearance of prepubertal or adolescent genitalia in children who have not been abused or injured in that area. McCann et al. reviewed the anal findings of 65 male and female subjects aged between 1 and 17 years at autopsy.³⁷ Some degree of anal dilatation was seen in 77% with the entire anal canal visible in 32%. The anterior–posterior diameter of the anal orifice increased with age.

6. Genital findings in children examined after allegations of child sexual abuse

Early papers documenting findings in children alleging sexual abuse suggested diagnostic findings could be found in 50–60% of complainants.^{38,39} It was also recognised that the genital examination could be normal even with perpetrator confession that penetration had occurred.⁴⁰ As more studies reported a greater range of genital findings in non-abused children it became apparent that a more cautious approach was indicated.⁴¹ Despite this some authors have persisted with a more inclusive diagnostic approach.⁴²

Berenson et al. reported the first case-control study of anatomic changes associated with sexual abuse.⁴³ The genital findings of 192 prepubertal children who had disclosed sexual assault with penetration were compared with those of 220 non-abused children. Vaginal discharge was observed more frequently in abused children. No significant differences were found between any of the features of the examination compared between the two groups, but four case children had findings not seen in non-abused children. These findings were a hymenal perforation, a hymenal transection and in two children a deep inferior hymenal notch. Deep notches are defined as extending greater than half the width of the hymenal membrane while a transection extends to the base of the hymen.

Heger et al. reported that 96.3% of 2384 children referred for evaluation of possible sexual abuse had a normal examination.⁴⁴ Diagnostic findings were found in only 5.5% of the 1134 children who alleged anal or vaginal penetration (6% of girls and 1% of boys). Even children referred for assessment because of physical signs or symptoms are more likely to have non-specific findings or other diagnoses than findings indicating sexual abuse.⁴⁵ Joyce

Adams has constructed a classification system of physical findings from genital examination in the context of allegations of sexual abuse.^{41,46} The latest version of the classification scale has been peer-reviewed by many experts in the field and lists only pregnancy and the finding of sperm as diagnostic of sexual contact.³⁴ Other significant findings are described as being diagnostic of trauma, which can include that associated with sexual assault. While this classification system is not universally accepted it does indicate that some consensus has been achieved about the interpretation of a range of genital findings.

There are a number of reasons why physical findings are uncommon in children alleging sexual abuse. The abusive acts perpetrated against children are usually different from those of adult sexual intercourse or rape. The perpetrator is usually known to the child, and it is not in their interests to hurt the child. A male abuser may be sexually aroused by the presence of the child and have had a genital-to-genital connection with the child without full penetration occurring. Most young children cannot clearly define to what depth penetration has occurred and do not understand the depth of penetration that occurs during adult sexual intercourse. Also, children often disclose some time after the abusive event. This means that superficial injuries will have healed.⁴⁷ Partial tears of the hymen may heal with the formation of the shallow notch of the hymen.⁴⁸ As these can be seen in non-abused girls such a finding cannot be interpreted as diagnostic of penetrative sexual assault if the finding is observed after the immediate post-assault period when the acute injury has healed. A full thickness tear of the hymen results in a transection which will persist but can only be distinguished from trauma due to accidental penetrating injury by history.^{48,49} In the study of Heppenstall-Heger et al., 37 prepubertal children had evidence of hymenal trauma when examined acutely and 17 of these were found to have transections of the hymen, 12 of whom disclosed experience of penile–vaginal penetration. One child was preverbal and the other four children had sustained a penetrating accidental injury.⁴⁸ For six of the children repair of the hymen was undertaken but was successful in only two so 15 of the original 17 had a persistent hymenal transection hymen on follow-up examination.

A few case reports have indicated some more unusual physical findings after sexual abuse. These include acquired imperforate hymen, rectovaginal fistula, anal fistulae and ruptured ectopic pregnancy in an 11 year-old.^{50–54}

A variety of anal findings have been described after allegations of sexual abuse but no case-control study of findings has been published. It is difficult to interpret studies reporting perianal injuries when it is not clear that all participants have alleged anal assault.⁵⁵ In boys anal findings are more common than genital findings.⁵⁶ Bruni reported on anal findings in 50 cases for which there had been indirect or direct perpetrator confession that anal penetration had occurred.⁵⁷ Only 6% had no abnormal findings but many of the findings documented have been reported in non-abused children. Scars were reported in 42 of the cases

but as these scars were not defined or described in detail it cannot be certain that the smooth midline region described by others in non-abused children was not mistaken for a scar. Anal fissures may be a late finding after anal sexual abuse but can also be associated with constipation in non-abused children.^{58,59} Anal lacerations seen acutely can heal without scarring.⁶⁰ Although rectal prolapse can occur in other paediatric medical conditions it has been reported in association with sexual abuse.⁶¹

7. Genital findings in adolescents examined after allegations of sexual abuse

The most common findings reported after historical allegations of sexual assault in adolescents have been a deep notch or transection of the posterior hymen.^{62,63} When the adolescent is examined more acutely after assault changes in the posterior fourchette are more commonly seen but significant hymenal injuries are rare.⁶⁴ As with pubertal children who allege assault with penetration, normal findings are more common than abnormal findings. Kellogg et al. reported on the genital findings of 36 pregnant adolescent girls examined because of allegations of sexual assault.⁶⁵ Only two had genital changes diagnostic of penetrating trauma.

8. Inflicted anogenital injuries that may not have a sexual motive

Harmful anogenital care practices inflicted on children may result in injury. These practices can include frequent genital inspections, cleaning, excessive application of creams to the genital area and forceful enemas.^{66,67} Injury to the hymen from penetration with a knife handle and anal injury from kicking with a bare foot have also been described.⁶⁸ In a review of 78 children who sustained burns involving the genital and perineal region 48% of burns in children less than 2 years were considered to have been inflicted.⁶⁹ Inflicted penile injuries in young boys usually have no sexual intent and may be associated with continence training.^{70,71} The presence of other abusive injuries such as fractures should be looked for.⁷²

9. Female genital mutilation

Female genital cutting (FGC), female genital mutilation, and female circumcision (FC) are all terms for procedures involving the partial or total removal of the external genitalia, or other injury to the female genitalia for cultural or other non-therapeutic reasons.⁷³ The practice is widespread in Africa, the Middle East, and Southeast Asia. Despite being illegal in their adopted countries, immigrant populations in Australasia, Europe and North America may still continue the practice. The procedure is categorised based on the degree of cutting. Type I involves excision of the prepuce and part or all of the clitoris, Type II involves excision of the prepuce and clitoris together with partial or

total excision of the labia minora, Type III involves infibulation and excision of part or all of the external genitalia and Type IV includes pricking, piercing, incision, stretching, scraping, or other harming procedures in the clitoris or labia.⁷⁴ Girls undergo FGC most commonly between 4 and 10 years of age but timing of the practice varies among cultures and may occur any time from birth to just before marriage.⁷⁵

10. Accidental injuries affecting the anogenital region

10.1. Prepubertal children

Accidental straddle injuries are more common in younger children and may result in significant bruising to the labia which takes the brunt of the impact.⁷⁵ Hymenal injury is rare in the absence of penetration but when accidental penetration does occur the resultant hymenal injury can mimic that seen after sexual assault.^{49,76–79} Accidental straddle injuries without penetration are more likely to cause injury anterior or lateral to the hymen.⁷⁸ Accidental falls involving rapid abduction of the legs can result in blunt soft tissue injury to the genital area and in particular the posterior fourchette.⁸⁰ Anogenital injuries may occur after road traffic accidents and falls from a height onto a penetrating object.^{81–83}

Crush injuries to the pelvis and lower abdomen may result in genital findings that mimic those seen after sexual assault.⁸⁴ A mechanism related to the increase in intra-abdominal pressure on impact is postulated. Genital injury has also been reported after a motor vehicle accident in a child travelling in the back seat with a seat belt incorrectly placed over her genital area.⁸⁵ Vaginal injuries have been reported by water jets such as may occur during play in a high pressure water fountain or hydroslide.⁸⁶ In young boys the penis can be injured accidentally with a zipper or crush injury.

10.2. Adolescents

Vaginal injuries have been reported in association with the use of tampons with plastic inserters.⁸⁷ Two subjects in the study of Adams et al. who denied sexual intercourse but had a deep or complete cleft of the posterior hymen reported painful insertion of a tampon the only time they had used them.³⁵

11. Anogenital findings that may be mistaken for signs of sexual abuse

A number of disorders affecting the anogenital region may be misinterpreted as physical indicators of sexual abuse by simulating either the appearance of healed trauma or signs of sexually transmitted infection. These include lichen sclerosus, vulvar pemphigoid, vaginal haemangiomas, urethral polyps, Behcet's syndrome, perianal streptococcal cellulitis, and congenital anomalies.^{88–94} The

perianal findings of Crohns disease may also be mistaken for sexual abuse.^{95–97} Perianal lymphangioma circumscriptum has been mistaken for genital warts.⁹⁸ Herpes zoster in the genital area may cause undue alarm when lesions appear in the genital area before the appearance of the more generalised rash.^{99,100} The rash of nickel allergy from a bed-wetting alarm has also been mistaken for herpes simplex and resulted in referral to protective services.¹⁰¹ Aphthous ulceration can occur in the genital area in association with acute illness.¹⁰² Ulcers in the genital area should not be presumed to be due to herpes simplex without confirmation by virological testing. Vaginal foreign bodies may present after a short or long history of genital symptoms and are usually self-inserted. Sexual abuse may be associated in some cases and should be considered if the object was not self-inserted.^{103,104}

12. The anogenital examination after suspected fatal child abuse

All forms of child abuse need to be considered at autopsy after a suspicious death. Usually the focus is on inflicted physical injury and the cause of death is a severe head injury. As physical abuse and sexual abuse can co-exist it is important to look carefully for evidence of genital injury.¹⁰⁵ In a review of 21 cases of fatal child abuse in Ontario, three cases had evidence of anogenital injury.¹⁰⁶ Rape homicide with death by strangulation has also been reported in children.¹⁰⁷ In a review of 41 fatal sexual assaults on women, six of the victims were aged less than 20 with three less than 15 years. Death is usually from strangulation.¹⁰⁸ Sexual abuse has also been reported in association with neglect by life-threatening starvation.¹⁰⁹

The genital region may not be fully examined at post mortem as rigor mortis will need to be overcome to examine the more internal genital structures. Visualisation of the genital area can be facilitated by the use of a colposcope or hand held magnification.¹¹⁰ Labial separation and labial traction will be required to fully examine the more internal genital structures. If there is significant injury to the external genital structures the possibility of vaginal lacerations with or without penetration into the peritoneum should be considered.⁶⁸ Death has been reported after anal intercourse with rectal perforation in a 21-month-old.¹¹¹ A search should be made for foreign bodies and trauma within the rectum.¹¹² Because of the paucity of literature on the appearance of the genitalia after death there should be caution about over-interpretation of findings on gross inspection. Completion of the autopsy as soon as possible is advisable. Dependent pooling of blood should not be confused with bruising. Studies documenting the range of genital findings seen after death in those not thought to have experienced inflicted or accidental genital injury are needed for both the paediatric and adolescent age groups. Until such guidance is available, samples for histology should be taken from all suspicious genital lesions to exclude the various disorders that can mimic signs of

inflicted genital trauma or sexually transmitted infection and rule out post mortem artefact. If evidence of trauma is found special dissection is necessary so that the rectum, anus and perianal tissues are removed *en bloc* with the perineum, uterus, vagina and vulva being included in the female. The attendance at the forensic autopsy of a paediatrician with expertise in child abuse can assist in the interpretation of findings and clinical photography can allow for expert second opinion at a later date.

13. Conclusion

An understanding of variations in genital anatomy is essential when examining the anogenital region of children and adolescents, as is an understanding of the physical findings that can mimic signs of sexual abuse. In the context of autopsy after fatal child abuse, evidence of sexual abuse is seen in a minority of cases but should still be carefully looked for. Injuries in the genital area may have been inflicted with physical rather than sexual intent. Evidence of sexual assault should be carefully looked for with child homicide due to strangulation. Because there are no reported studies of examination of the genitalia after death in non-abused female children and adolescents a cautious approach to the interpretation of non-specific findings should be maintained. All suspicious lesions should be examined histologically to confirm their significance and rule out other disorders that can mimic signs of sexual abuse. In both children and adolescents normal genital appearance at autopsy does not rule out a history of sexual abuse, nor in adolescents does it exclude consensual sexual intercourse.

References

1. Kempe C, Silverman F, Steele B, et al. The battered-child syndrome. *JAMA* 1962;**181**:105–12.
2. Fergusson D, Lynskey M, Horwood L. Childhood sexual abuse and psychiatric disorder in young adulthood: I. Prevalence of sexual abuse and factors associated with sexual abuse. *J Am Acad Child Adolesc Psychiatry* 1996;**35**:1355–64.
3. Fleming J. Prevalence of childhood sexual abuse in a community sample of Australian women. *Med J Aust* 1997;**166**:65–8.
4. American Professional Society on the Abuse of Children. *Glossary of terms and the interpretation of findings for child sexual abuse evidentiary examinations*. Chicago: American Professional Society on the Abuse of Children; 1998.
5. Jenny C, Kuhns M, Arakawa F. Hymens in newborn female infants. *Pediatrics* 1987;**80**:399–400.
6. Mor N, Merlob P, Reisner S. Types of hymen in the newborn infant. *Eur J Obstet Gynecol Reprod Biol* 1986;**22**:225–8.
7. Berenson A, Heger A, Andrews S. Appearance of the hymen in newborns. *Pediatrics* 1991;**87**:458–65.
8. Berenson A. Normal anogenital anatomy. *Child Abuse Negl* 1998;**22**:589–96.
9. Berenson A. Appearance of the hymen at birth and one year of age: a longitudinal study. *Pediatrics* 1993;**91**:820–5.
10. Berenson A, Grady J. A longitudinal study of hymenal development from 3 to 9 years of age. *J Pediatr* 2002;**140**:600–7.
11. Berenson A. A longitudinal study of hymenal morphology in the first 3 years of life. *Pediatrics* 1995;**95**:490–6.

12. Berenson A, Heger A, Hayes J, et al. Appearance of the hymen in prepubertal girls. *Pediatrics* 1992;**89**:387–94.
13. Gardner J. Descriptive study of genital variation in healthy, nonabused premenarchal girls. *J Pediatr* 1992;**120**:251–7.
14. Heger A, Ticson L, Guerra L, et al. Appearance of the genitalia in girls selected for nonabuse: review of hymenal morphology and nonspecific findings. *J Pediatr Adolesc Gynecol* 2002;**15**:27–35.
15. Myhre A, Berntzen K, Bratlid D. Genital anatomy in non-abused preschool girls. *Acta Paediatr* 2003;**92**:1453–62.
16. McCann J, Wells R, Simon M, et al. Genital findings in prepubertal girls selected for nonabuse: a descriptive study. *Pediatrics* 1990;**86**:428–39.
17. Kellogg N, Parra J. Linea vestibularis: a previously undescribed normal genital structure in female neonates. *Pediatrics* 1991;**87**:926–9.
18. Kellogg N, Parra J. Linea vestibularis: follow-up of a normal genital structure. *Pediatrics* 1993;**92**:453–6.
19. Leung A, Robson W, Tay-Uyboco J. The incidence of labial fusion in children. *J Paediatr Child Health* 1993;**29**:235–6.
20. Berkowitz C, Elvik S, Logan M. Labial fusion in prepubescent girls: a marker for sexual abuse? *Am J Obstet Gynecol* 1987;**156**:16–20.
21. McCann J, Voris J, Simon M. Labial adhesions and posterior fourchette injuries in childhood sexual abuse. *Am J Dis Child* 1988;**142**:659–63.
22. Cantwell H. Vaginal inspection as it relates to child sexual abuse in girls under thirteen. *Child Abuse Negl* 1983;**7**:171–6.
23. White S, Ingram D, Lyna P. Vaginal introital diameter in the evaluation of sexual abuse. *Child Abuse Negl* 1989;**13**:217–24.
24. Goff C, Burke K, Rickenback C, et al. Vaginal opening measurement in prepubertal girls. *Am J Dis Child* 1989;**143**:1366–8.
25. Ingram D, Everett V, Ingram D. The relationship between the transverse hymenal orifice diameter by the separation technique and other possible markers of sexual abuse. *Child Abuse Negl* 2001;**25**:1109–20.
26. Berenson A, Chacko M, Wiemann C, et al. Use of hymenal measurements in the diagnosis of previous penetration. *Pediatrics* 2002;**109**:228–35.
27. McCann J, Voris J, Simon M, et al. Perianal findings in prepubertal children selected for nonabuse: a descriptive study. *Child Abuse Negl* 1989;**13**:179–93.
28. Berenson A, Somma-Garcia A, Barnett S. Perianal findings in infants 18 months of age or younger. *Pediatrics* 1993;**91**:838–40.
29. Myhre A, Berntzen K, Bratlid D. Perianal anatomy in non-abused preschool children. *Acta Paediatr* 2001;**90**:1321–8.
30. Suarez L, Belanger-Quintana A, Escobar H, et al. Suspected sexual abuse: an unusual presentation form of congenital myotonic dystrophy. *Eur J Pediatr* 2000;**159**:539–41.
31. Hobbs C, Wynne J. Buggery in childhood – a common syndrome of child abuse. *Lancet* 1986;**2**:792–6.
32. Clayden G. Reflex anal dilatation associated with severe chronic constipation in children. *Arch Dis Child* 1988;**63**:832–6.
33. Harvey I, Nowlan W. Reflex anal dilatation: clinical epidemiology evaluation. *Paediatr Perinat Epidemiol* 1989;**3**:294–301.
34. Adams J. Approach to the interpretation of medical and laboratory findings in suspected child sexual abuse: a 2005 revision. *APSAC advisor* 2005;**17**:7–12.
35. Adams J, Botash A, Kellogg N. Difference in hymenal morphology between adolescent girls with and without a history of consensual sexual intercourse. *Arch Pediatr Adolesc Med* 2004;**158**:280–5.
36. Pokorny S, Murphy J, Preminger M. Circumferential hymen elasticity. A marker of physiologic maturity. *J Reprod Med* 1998;**43**:943–8.
37. McCann J, Reay D, Siebert J, et al. Postmortem perianal findings in children. *Am J Forensic Med Pathol* 1996;**17**:289–98.
38. Muram D. Child sexual abuse-genital tract findings in prepubertal girls. *Am J Obstet Gynecol* 1989;**160**:333–5.
39. Claytor R, Barth K, Shubin C. Evaluating child sexual abuse: observations regarding ano-genital injury. *Clin Pediatrics* 1989;**28**:419–22.
40. Muram D. Child sexual abuse: relationship between sexual acts and genital findings. *Child Abuse Negl* 1989;**13**:211–6.
41. Adams J, Harper K, Knudson S. A proposed system for classification of anogenital findings in children with suspected sexual abuse. *Adolesc Pediatr Gynecol* 1992;**5**:73–5.
42. Hobbs C, Wynne J, Thomas A. Colposcopic genital findings in prepubertal girls assessed for sexual abuse. *Arch Dis Child* 1995;**73**:465–71.
43. Berenson A, Chacko M, Wiemann C, et al. A case-control study of anatomic changes resulting from sexual abuse. *Am J Obstet Gynecol* 2000;**182**:820–34.
44. Heger A, Ticson L, Velasquez O, et al. Children referred for possible sexual abuse: medical findings in 2384 children. *Child Abuse Negl* 2002;**26**:645–59.
45. Kellogg N, Parra J, Menard S. Children with anogenital symptoms and signs referred for sexual abuse evaluations. *Arch Pediatr Adolesc Med* 1998;**152**:634–41.
46. Adams J. Evolution of a classification scale: medical evaluation of suspected child sexual abuse. *Child Maltreatment* 2001;**6**:31–6.
47. Finkel M. Anogenital trauma in sexually abused children. *Pediatrics* 1989;**84**:317–22.
48. Heppenstall-Heger A, McConnell G, Ticson L, et al. Healing patterns in anogenital injuries: a longitudinal study of injuries associated with sexual abuse, accidental injuries, or genital surgery in the preadolescent child. *Pediatrics* 2003;**112**:829–37.
49. Muram D, Levitt C, Frasier L, et al. Genital Injuries. *J Pediatr Adolesc Gynecol* 2003;**16**:149–55.
50. Berkowitz C, Elvik S, Logan M. A simulated “acquired” imperforate hymen following the genital trauma of sexual abuse. *Clin Pediatrics* 1987;**26**:307–9.
51. Botash A, Jean-Louise F. Imperforate hymen: congenital or acquired from sexual abuse. *Pediatrics* 2001;**108**:e53.
52. Kellogg N, Parra J. A rectovaginal fistula in a sexually assaulted child. *Clin Pediatrics* 1996;**35**:369–71.
53. Lahoti S, McNeese M, McClain N, et al. Two cases of anal fistula in girls evaluated for sexual abuse. *J Pediatr Surg* 2002;**37**:132–3.
54. Marconi J, Turow V, Esernio-Jenssen D, et al. Ruptured ectopic pregnancy complicating sexual abuse in an 11-year-old girl. *J Pediatr* 1990;**117**:739–41.
55. Muram D. Anal and perianal abnormalities in prepubertal victims of sexual abuse. *Am J Obstet Gynecol* 1989;**161**:278–81.
56. De Jong A, Emmett G, Hervada A. Epidemiologic factors in sexual abuse of boys. *Am J Dis Child* 1982;**136**:990–3.
57. Bruni M. Anal findings in sexual abuse of children. *J Forensic Sci* 2003;**48**:1343–6.
58. Ameh E. Anal injury and fissure-in-ano from sexual abuse in children. *Ann Tropical Paediatr* 2001;**21**:273–5.
59. Pierce A. Anal fissures and anal scars in anal abuse – are they significant? *Pediatr Surg Int* 2004;**20**:334–8.
60. McCann J, Voris J. Perianal injuries resulting from sexual abuse: a longitudinal study. *Pediatrics* 1993;**91**:390–7.
61. Loreda-Abdala A, Trejo-Hernandez J, Monroy-Villafuente A, et al. letter. *Clin Pediatrics* 2000;**39**:131–2.
62. Adams J, Knudson S. Genital findings in adolescent girls referred for suspected sexual abuse. *Arch Pediatr Adolesc Med* 1996;**150**:850–7.
63. Edgardh K, Ormstad K. The adolescent hymen. *J Reproduct Med* 2002;**47**:710–4.
64. Adams J, Girardin B, Faugno D. Adolescent sexual assault: documentation of acute injuries using photo-colposcopy. *J Pediatr Adolesc Gynecol* 2001;**14**:175–80.
65. Kellogg N, Menard S, Santos A. Genital anatomy in pregnant adolescents: “Normal” does not mean “nothing happened”. *Pediatrics* 2004;**113**:e67.
66. Herman-Giddens M, Berson N. Harmful genital care practices in children. *JAMA* 1989;**261**:577–9.
67. Jones L, Bass D. Perineal injuries in children. *Br J Surg* 1991;**78**:1105–7.

68. Elder D. Inflicted anogenital injury in children: physical abuse or sexual abuse? *Forensic Med Sci Pathol* 2006;**2**:25–8.
69. Angel C, Shu T, French D, et al. Genital and perineal burns in children: 10 years of experience at a major burn center. *J Pediatr Surg* 2002;**37**:99–103.
70. Lukschu M, Bays J. Inflicted incision of the penis. *Child Abuse Negl* 1996;**20**:979–81.
71. Feldman K. Letter. *Child Abuse Negl* 1997;**21**:253–4.
72. Slosberg E, Ludwig S, Duckett J, et al. Penile trauma as a sign of child abuse. *Am J Dis Child* 1978;**132**:719–20.
73. Merritt D. Vulvar and genital trauma in pediatric and adolescent gynecology. *Curr Opin Obstet Gynecol* 2004;**16**:371–81.
74. Elmusharaf S, Elhadi N, Almroth L. Reliability of self reported form of female genital mutilation and WHO classification: cross sectional study. *BMJ* 2006;**333**:124–8.
75. West R, Davies A, Fenton T. Accidental vulval injuries in childhood. *BMJ* 1989;**298**:1003–4.
76. Boos S. Accidental hymenal injury mimicking sexual trauma. *Pediatrics* 1999;**103**:1287–90.
77. Dowd M, Fitzmaurice L, Knapp J, et al. The interpretation of urogenital findings in children with straddle injuries. *J Pediatr Surg* 1994;**29**:7–10.
78. Bond G, Dowd M, Landsman I, et al. Unintentional injury in prepubescent girls: a multicenter prospective report of 56 girls. *Pediatrics* 1995;**95**:628–31.
79. Hostetler B, Muram D, Jones C. Sharp penetrating injuries to the hymen. *Adolesc Pediatr Gynecol* 1994;**7**:94–6.
80. Herrmann B, Crawford J. Genital injuries in prepubertal girls from inline skating accidents. *Pediatrics* 2002;**110**:e16.
81. Ameh E. Anorectal injuries in children. *Pediatr Surg Int* 2000;**16**:388–91.
82. Vinsant G, Buntain W. Blunt anorectal injuries in children. *J Tenn Med Assoc* 1985;**78**:158–60.
83. Scheidler M, Shultz B, Schall L, et al. Mechanisms of blunt perineal injury in female pediatric patients. *J Pediatr Surg* 2000;**35**:1317–9.
84. Boos S, Rosas A, Boyle C, et al. Anogenital injuries in child pedestrians run over by low-speed motor vehicles: four cases with findings that mimic child sexual abuse. *Pediatrics* 2003;**112**:e77.
85. Baker R. Seat belt injury masquerading as sexual abuse. *Pediatrics* 1986;**77**:435.
86. Aho T, Upadhyay V. Vaginal water-jet injuries in premenarcheal girls. *NZ Med J*:118 <http://www.nzma.org.nz/journal/118-1218/1565/>.
87. Gray M, Norton P, Treadwell K. Tampon-induced injuries. *Obstet Gynecol* 1981;**58**:667–8.
88. Wood P, Bevan T. Child sexual abuse enquiries and unrecognised vulval lichen sclerosus et atrophicus. *BMJ* 1999;**319**:899–900.
89. Levine V, Sanchez M, Nestor M. Localized vulvar pemphigoid in a child misdiagnosed as sexual abuse. *Arch Dermatol* 1992;**128**:804–6.
90. Bays J, Jenny C. Genital and anal conditions confused with child sexual abuse trauma. *Am J Dis Child* 1990;**144**:1319–22.
91. Young S, Wells D, Ogden E. Lichen sclerosis, genital trauma and child sexual abuse. *Aust Fam Phys* 1993;**22**:729–33.
92. French G, Johnson C. Genital bleeding: two uncommon causes in patients referred to a sexual abuse clinic. *Clin Pediatrics* 1994;**33**:38–41.
93. Dodds M. Vulvar disorders of the infant and young child. *Clin Obstet Gynecol* 1997;**40**:141–52.
94. Al-Khenaizan S, Almuneef M, Kentab O. Lichen sclerosus mistaken for child sexual abuse. *Int J Dermatol* 2005;**44**:317–20.
95. Stratakis C, Graham W, DiPalma J, et al. Misdiagnosis of perianal manifestations of Crohn's disease. *Clin Pediatrics* 1994;**33**:631–3.
96. Sellman S, Hupertz V, Reece R. Crohn's disease presenting as suspected abuse. *Pediatrics* 1996;**97**:272–4.
97. Porzionato A, Alaggio R, Aprile A. Perianal and vulvar Crohn's disease presenting as suspected abuse. *Forensic Sci Int* 2005;**155**:24–7.
98. Darmstadt G. Perianal lymphangioma circumscripsum mistaken for genital warts. *Pediatrics* 1996;**98**:461–3.
99. Christian C, Singer M, Crawford J, et al. Perianal herpes zoster presenting as suspected child abuse. *Pediatrics* 1997;**99**:608–10.
100. Simon H, Steele D. Varicella: pediatric genital/rectal vesicular lesions of unclear origin. *Ann Emerg Med* 1995;**25**:111–4.
101. Hanks J, Venters W. Nickel allergy from a bed-wetting alarm confused with herpes genitalis and child abuse. *Pediatrics* 1992;**90**:458–60.
102. Huppert J, Gerber M, Deitch H, et al. Vulvar ulcers in young females: a manifestation of aphthosis. *J Pediatr Adolesc Gynecol* 2006;**19**:195–204.
103. Herman-Giddens M. Vaginal foreign bodies and child sexual abuse. *Arch Pediatr Adolesc Med* 1994;**148**:195–200.
104. Stricker T, Navratil F, Sennhauser F. Vaginal foreign bodies. *J Paediatr Child Health* 2004;**40**:205–7.
105. Kellogg N, Menard S. Violence among family members of children and adolescents evaluated for sexual abuse. *Child Abuse Negl* 2003;**27**:1367–76.
106. Pollanen M, Smith C, Chiasson D, et al. Fatal child abuse-maltreatment syndrome. A retrospective study in Ontario, Canada, 1990–1995. *Forensic Sci Int* 2002;**126**:101–4.
107. Schmidt P, Madea B. Rape homicide involving children. *J Clin Forensic Med* 1999;**6**:90–4.
108. Deming J, Mittleman R, Wetli C. Forensic Science Aspects of fatal sexual assaults on women. *J Forensic Sci* 1983;**28**:572–6.
109. Kellogg N, Lukefahr J. Criminally prosecuted cases of child starvation. *Pediatrics* 2005;**116**:1309–16.
110. Crowley S. A mobile system for postmortem genital examinations with colposcopy: SART-TO-GO. *J Forensic Sci* 2004;**49**:1299–307.
111. Orr C, Clark M, Hawley D, et al. Fatal anorectal injuries: a series of four cases. *J Forensic Sci* 1995;**40**:219–21.
112. Kirschner R, Wilson H. Pathology of fatal abuse. In: Reece R, Ludwig S, editors. *Child abuse: medical diagnosis and management*. Philadelphia: Lippincott Williams & Wilkins; 2001. p. 467–516.